# Workshop on Security Certification and Accreditation of IT Systems

*The Development of Standardized Certification and Accreditation Guidelines and Provider Organizations*

Dr. Ron Ross

# Workshop Agenda

- Introduction to the NIST Certification and Accreditation Program
- Introduction to NIST Special Publication 800-37
- Practical exercise on the use of Special Publication 800-37

# Schedule

- 0900-0930 Introduction to C&A Program
- 0930-1000 NIST SP 800-37
- 1000-1015 Break
- 1015-1100 NIST SP 800-37
- 1100-1115 Break
- 1115-1200 Practical exercise
- 1200-1230 Q&A

# NIST Security Certification and Accreditation Program

*The Development of Standardized Guidelines and Provider Organizations*

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# Today's Climate

- Highly interactive environment of powerful computing devices and interconnected systems of systems across global networks
- Federal agencies routinely interact with industry, private citizens, state and local governments, and the governments of other nations
- The complexity of today's systems and networks presents great security challenges for both producers and consumers of information technology

# Today's Challenge

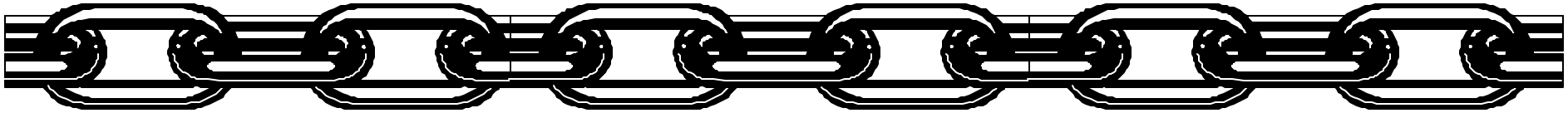
- Need for greater confidence in the security of enterprise IT systems
- Need for consistency in the approaches used to assess the capabilities and limitations of IT systems in Federal agencies
- Need for competent personnel with requisite skill sets to conduct IT system assessments

# Security Assurance in IT Systems

***Building more secure systems requires --***

- Well defined system-level security requirements and security specifications
- Well designed component products
- Sound systems security engineering practices
- Competent systems security engineers
- Appropriate metrics for product/system testing, evaluation, and assessment
- Comprehensive system security planning and life cycle management

# The Security Chain



## Links in the Chain
(Non-technology based examples)

- ✓ Physical security
- ✓ Personnel security
- ✓ Procedural security
- ✓ Risk management
- ✓ Security policies
- ✓ Security planning
- ✓ Contingency planning

## Links in the Chain
(Technology based examples)

- ✓ Access control mechanisms
- ✓ Identification and authentication devices
- ✓ Audit mechanisms
- ✓ Encryption mechanisms
- ✓ Firewalls
- ✓ Smart cards
- ✓ Biometrics

Adversaries attack the weakest link…where is yours?

# System Accreditation

"*A management decision by a senior agency official to authorize operation of an IT system based on the results of a certification process and other relevant considerations…*"

- Assigns responsibility for the safe and secure operation of an IT system to a designated authority
- Balances mission requirements and the residual risks to an IT system after the employment of appropriate protection measures (security controls)

# Security Certification

*"A comprehensive analysis of the technical and non-technical aspects of an IT system in its operational environment to determine compliance to stated security requirements and controls…"*

- Employs a set of structured verification techniques and verification procedures during the system life cycle
- Demonstrates the security controls for an IT system are implemented correctly and are effective
- Identifies risks to confidentiality, integrity, and availability of information and resources

# Program Objectives

***Phase I***

- To develop standardized guidelines for conducting security certifications and accreditations of federal IT systems
- ***Phase II***
- To create a national network of accredited organizations capable of providing cost effective, quality security assessment services based on the standardized guidelines

***PHASE I***

# Development of Guidance

- NIST Special Publication 800-37

  ***Guidelines for the Security Certification and Accreditation of Federal Information Technology Systems***

- NIST Special Publication 800-53

  ***Minimum Security Controls for Federal Information Technology Systems***

- NIST Special Publication 800-53A

  ***Techniques and Procedures for the Verification of Security Controls in Federal Information Technology Systems***

***PHASE II***

# Development of Capability

- Create criteria for accrediting public and private sector organizations to conduct security certifications in accordance with NIST Special Publication 800-37
- Develop associated proficiency tests to demonstrate assessment organization competence
- Accredit public and private sector enterprises to conduct security certifications by Fall 2004

# Significant Benefits

- More consistent, comparable, and repeatable system-level evaluations or system certifications of federal IT systems
- More complete, reliable technical information for IT system accreditation authorities—leading to better understanding of complex systems and associated risks and vulnerabilities
- Greater availability of competent certification services for public and private sector customers

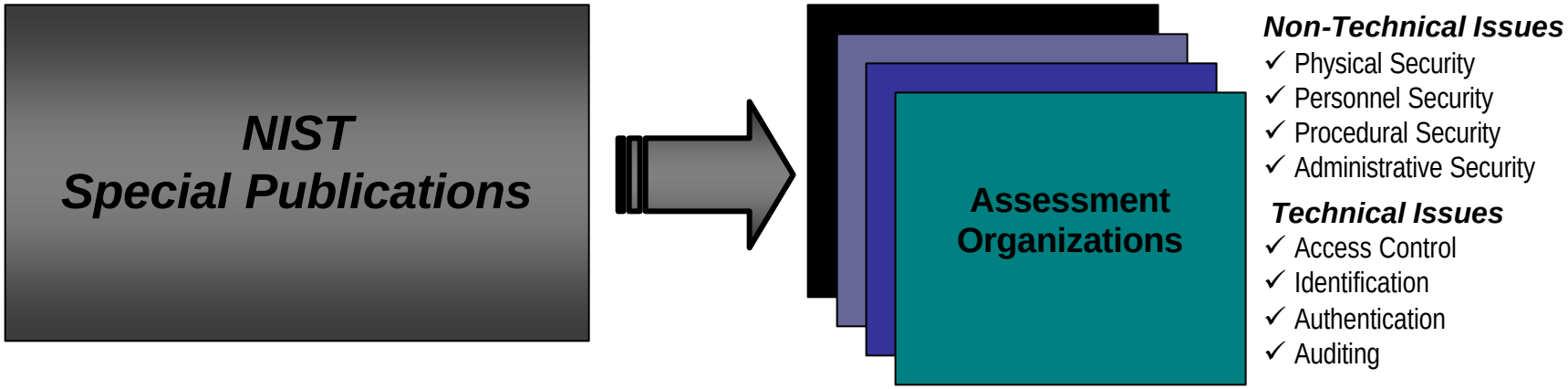
# Development Strategy

- Limited federal government involvement
  - ✓ **Develop and maintain standardized system certification and accreditation guidelines (Special Publication 800-37)**
  - ✓ **Develop and maintain standardized (minimum) security controls and verification techniques/procedures (Special Publications 800-53 and 800-53A)**
  - ✓ **Develop and maintain assessment organization program (i.e., accreditation criteria and assessment methods for participating organizations)**
  - ✓ **Accredit public and private sector assessment organizations to for competence**
- Maximum use of private sector capabilities
  - ✓ **Collaborate with industry on security C&A guideline development**
  - ✓ **Encourage private sector development of C&A tools and training classes**
  - ✓ **Use private sector assessment organizations to conduct security certifications for federal customers (when desired)**

# Comprehensive Security Program

**Standardized Guidelines for Certification and Accreditation**

**Network of Accredited Assessment Organizations**

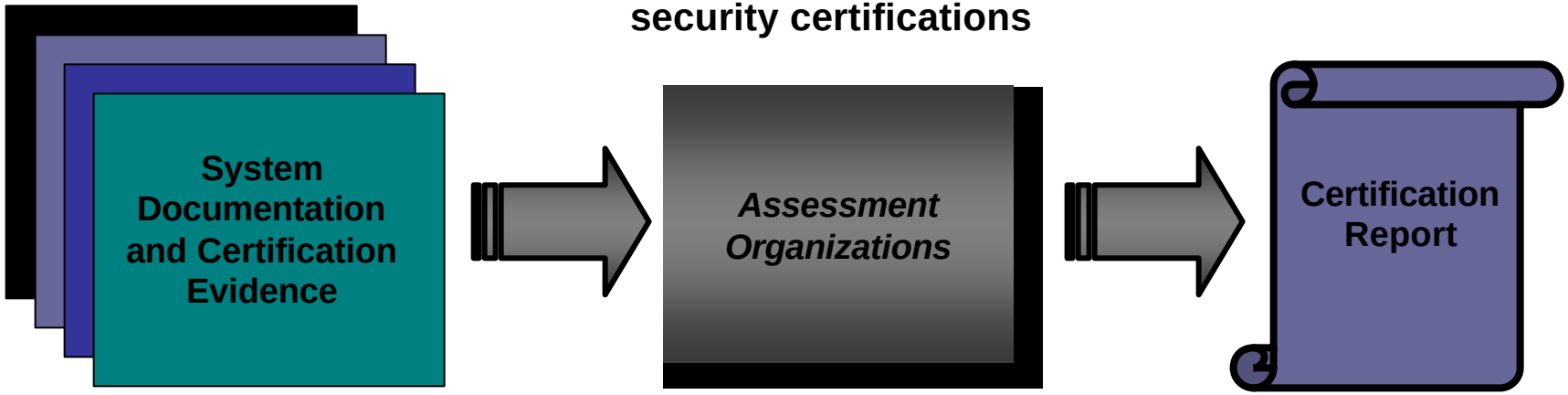



*A flexible, tailorable, and robust security certification process for federal agencies*

*Competent providers of security assessment services*

# Assessing System Security

**Public and private sector, accredited assessment organizations conduct security certifications**




**Program managers or system owners provide system documentation to independent, impartial certification agents**

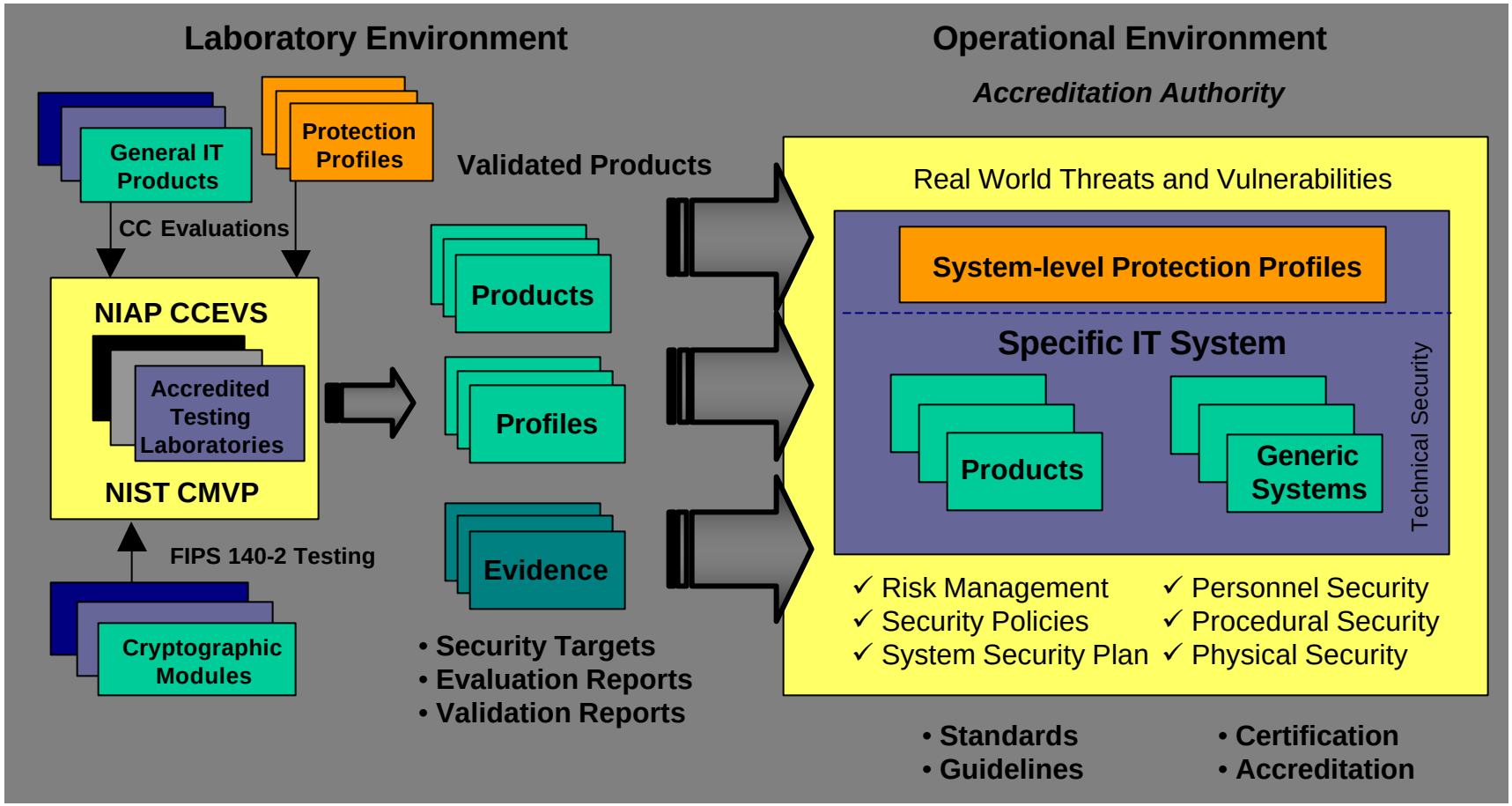
**Certification results submitted to agency officials for final decisions on authorizations to operate the systems**

# Product Testing Programs

- NIST Cryptographic Module Validation Program
  - ✓ Testing commercial cryptographic modules against U.S. Government Standard (FIPS 140-2 *Security Requirements for Cryptographic Modules*)
  - ✓ Independent, private-sector, accredited testing laboratories with validation of test results by NIST and CSE (Canada)
- NIAP Common Criteria Evaluation and Validation Program
  - ✓ Testing commercial IT products against international standard (ISO/IEC 15408 *Common Criteria for IT Security Evaluation*)
  - ✓ Independent, private-sector, accredited testing laboratories with validation of test results by NIST and NSA

# A Comprehensive Approach

## Linking Critical Assessment Activities



# NIST Special Publication 800-37

Guidelines for the Security Certification and Accreditation of Federal Information Technology Systems

Dr. Ron Ross

# Topics

- Introduction
- The Fundamentals of Certification and Accreditation
- Security Certification Levels and Security Controls
- Certification and Accreditation Process
- Future Activities

# Part I
# Introduction

# National Policy

Office of Management and Budget Circular A-130, *Management of Federal Information Resources* requires federal agencies to:

- Plan for security
- Ensure that appropriate officials are assigned security responsibility
- Authorize system processing prior to operations and periodically, thereafter.

# Achieving Adequate Security

- OMB Circular A-130 defines *adequate security* as security commensurate with the risk and magnitude of harm resulting from the loss, misuse, or unauthorized access to or modification of information
- Adequate security emphasizes the risk-based policy for cost-effective security established by Public Law 100-235, the Computer Security Act of 1987

# System Accreditation

"*A management decision by a senior agency official to authorize operation of an IT system based on the results of a certification process and other relevant considerations…*"

- Assigns responsibility for the safe and secure operation of an IT system to a designated authority
- Balances mission requirements and the residual risks to an IT system after the employment of appropriate protection measures (security controls)

# Security Certification

"*A comprehensive analysis of the technical and non-technical aspects of an IT system in its operational environment to determine compliance to stated security requirements and controls…*"

- Employs a set of structured verification techniques and verification procedures during the system life cycle
- Demonstrates the security controls for an IT system are implemented correctly and are effective
- Identifies risks to confidentiality, integrity, and availability of information and resources

# Special Publication 800-37

***Guidelines for the Security Certification and Accreditation of Federal Information Technology Systems***

- Establishes a standard process, general tasks and specific subtasks to certify and accredit IT systems supporting the executive branch of the federal government
- Focuses on federal systems processing, storing and transmitting sensitive (unclassified) information but can be applied to national security or intelligence systems, if so directed by appropriate authorities
- Supercedes NIST Federal Information Processing Standards (FIPS) Publication 102
- Projected publication of draft (Fall 2002)

# Related Publications

- NIST Special Publication 800-53
  *Minimum Security Controls for Federal Information Technology Systems* (Spring 2003)
- NIST Special Publication 800-53A
  *Techniques and Procedures for the Verification of Security Controls in Federal Information Technology Systems* (Spring 2003)

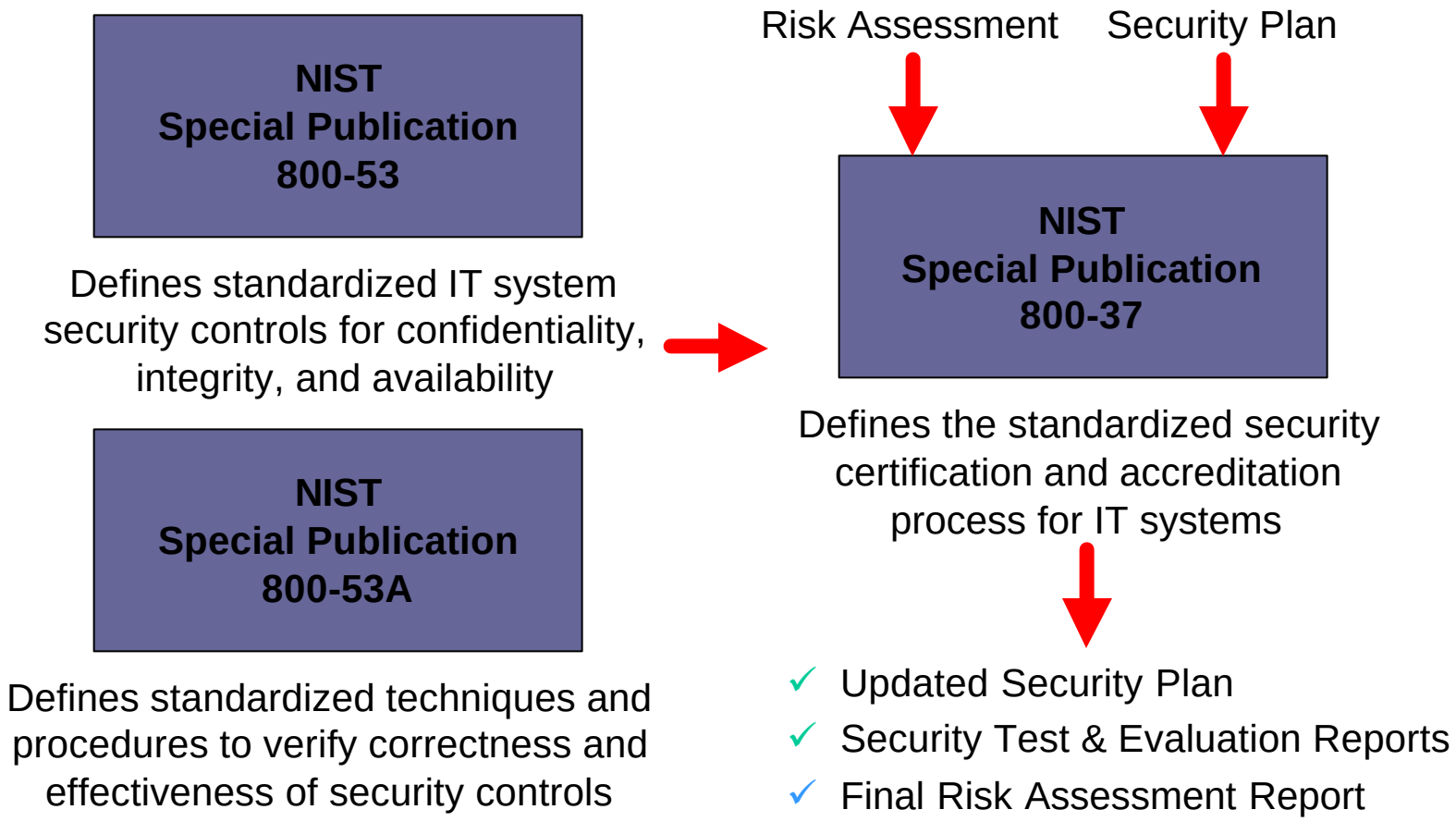
# Significant Features

- Employs a standardized process for the certification and accreditation of IT systems
- Integrates the use of standardized security controls and standardized verification techniques/ procedures
- Minimizes documentation required and produced during the C&A process
- Maximizes the cost-effective production of essential evidence to support informed, risk-based accreditation decisions by senior agency officials

# Significant Benefits

- More consistent, comparable, and repeatable system-level evaluations or system certifications of federal IT systems
- More complete, reliable technical information for IT system accreditation authorities—leading to better understanding of complex systems and associated risks and vulnerabilities

# Security Accreditation Model



# Special Publication 800-53

***Minimum Security Controls for Federal Information Technology Systems***

- Provides standardized security controls for confidentiality, integrity, and availability
- Arrays controls in a standard package of basic controls (low levels of concern for C, I, A)
- Offers optional controls for moderate and high levels of concern in agency-defined supplemental package
- Represents the integration of security controls from many policies, directives, and guidelines (e.g., NIST SP 800-26, DoD 8500, D/CID 6/3, ISO/IEC 17799, and FISCAM)
- Projected publication Spring 2003

# Special Publication 800-53A

***Techniques and Procedures for the Verification of Security Controls in Federal Information Technology Systems***

- Provides standardized verification techniques and detailed verification procedures for security controls in SP 800-53
- Associates verification techniques with the Security Certification Levels in SP 800-37 and addresses the level of rigor applied to the security test and evaluation activities
- Specifies certifier actions necessary to demonstrate correct and effective implementation of security controls in SP 800-53
- Projected publication Spring 2003

Part II

# The Fundamentals of Security Certification and Accreditation

# Key Roles

- Designated Approving Authority
- Certifier and Certification Team
- Program Manager or System Owner
- System Security Officer

# Other Supporting Roles

- User Representative
- Security Program Manager
- Operations Manager
- Facility Manager

# Landscape of IT Systems

- Major Applications
- General Support Systems
- Special Cases

# Major Applications

- Applications requiring special management oversight because of the particular type of information processed, stored, or transmitted by the application, or because of the criticality of the application to the agency mission
- Systems that perform clearly defined functions for which there are readily identifiable security considerations and needs, (e.g., an electronic funds transfer system or global command and control system)
- Comprised of many individual programs and hardware, software, and telecommunications components
- Represented as single software application or a combination of hardware/software focused on supporting a specific mission-related function.

# General Support Systems

- A collection of interconnected information resources or computing environments under the same direct management control, which shares common functionality
- Provides support for a variety of users and/or common applications and includes hardware, software, information, data, applications, communications, facilities, and people
- Potentially hosts one or more major applications
- Examples:
  - ✓ Local area networks (LAN) including smart terminals that support a branch office
  - ✓ Backbone networks, (e.g., agency-wide), and communications networks
  - ✓ Departmental data processing centers including its operating system and utilities
  - ✓ Tactical radio network, office automation and electronic mail services, or shared information processing service organization

# Special Cases

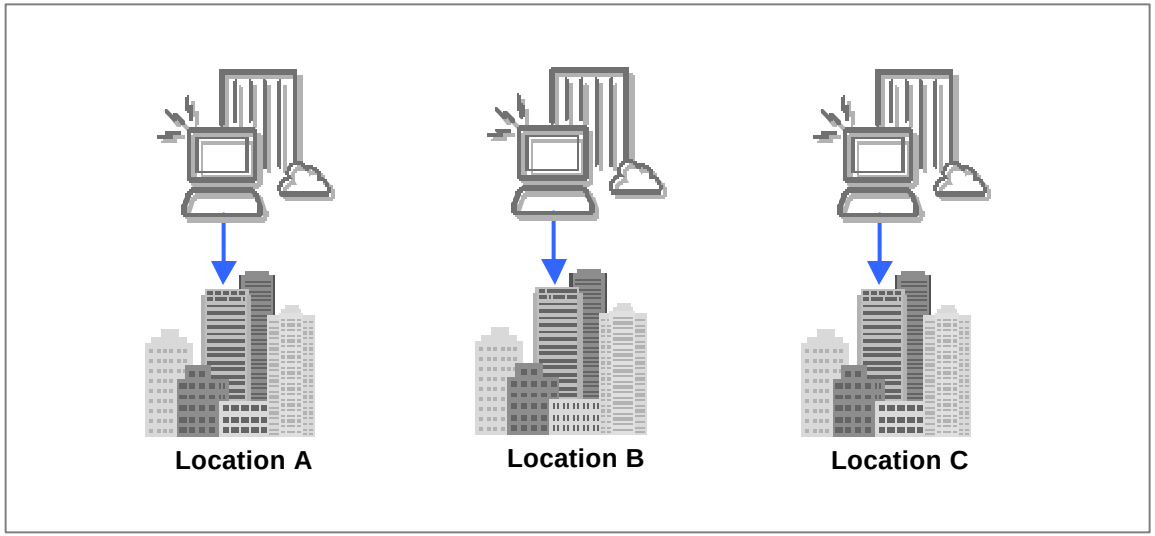
- Platform IT Interconnections
  - Network access to computer resources, both hardware and software, that are physically part of, dedicated to, or essential in real time to the mission performance of special purpose systems such as weapons systems, training simulators, diagnostic test and maintenance equipment, calibration equipment, equipment used in the research and development of weapons systems, medical technologies, transport vehicles, and utility distribution systems
- Outsourced IT Processes
  - Outsourced business processes supported by private sector IT systems
  - Outsourced information technologies
  - Outsourced information services

# Accreditation Categories

- System Accreditation
- Type Accreditation
- Site Accreditation

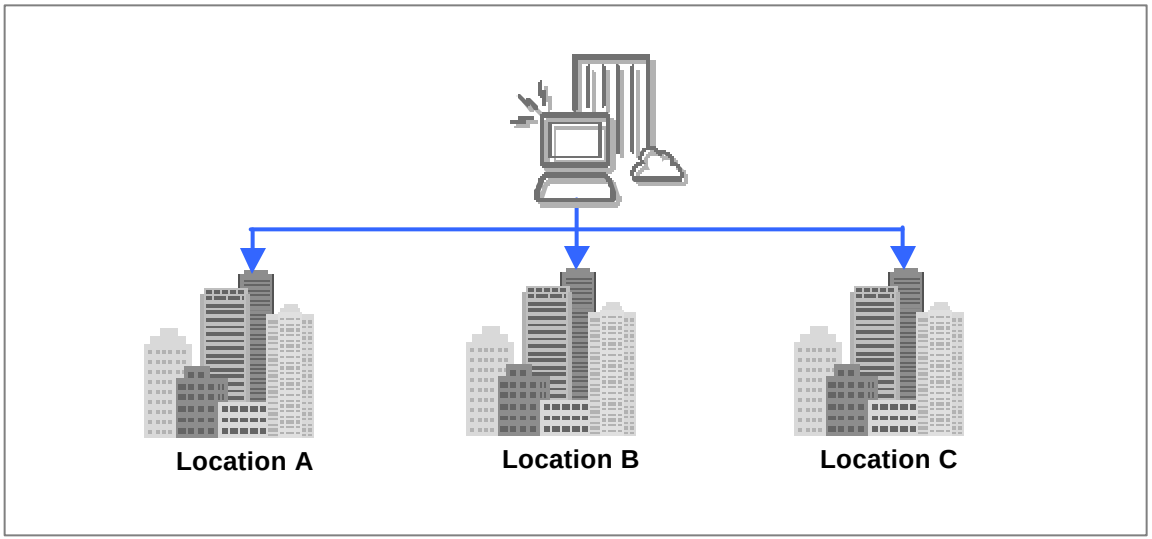
# System Accreditation

- Most common type of accreditation that authorizes the operation of a major application or a general support system at a particular location with specified environmental constraints



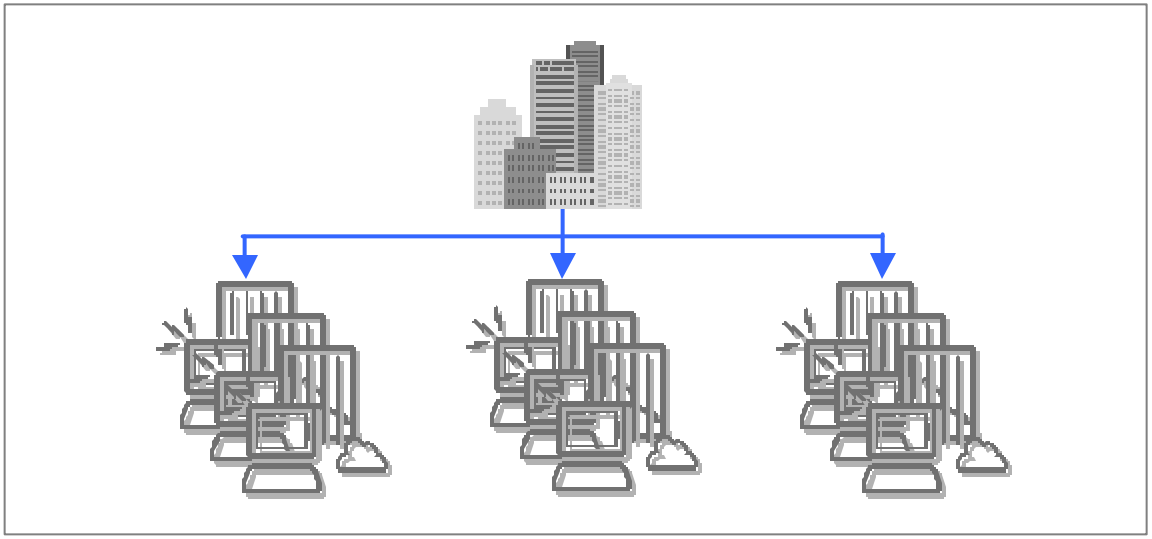
# Type Accreditation

- Major applications or general support systems
- Common set of hardware, software, and/or firmware
- Intended for installation at multiple locations
- Form of interim accreditation



# Site Accreditation

- Major applications or general support systems with common mission and common threats/vulnerabilities
- Several agency organizations in self-contained location; common senior executive



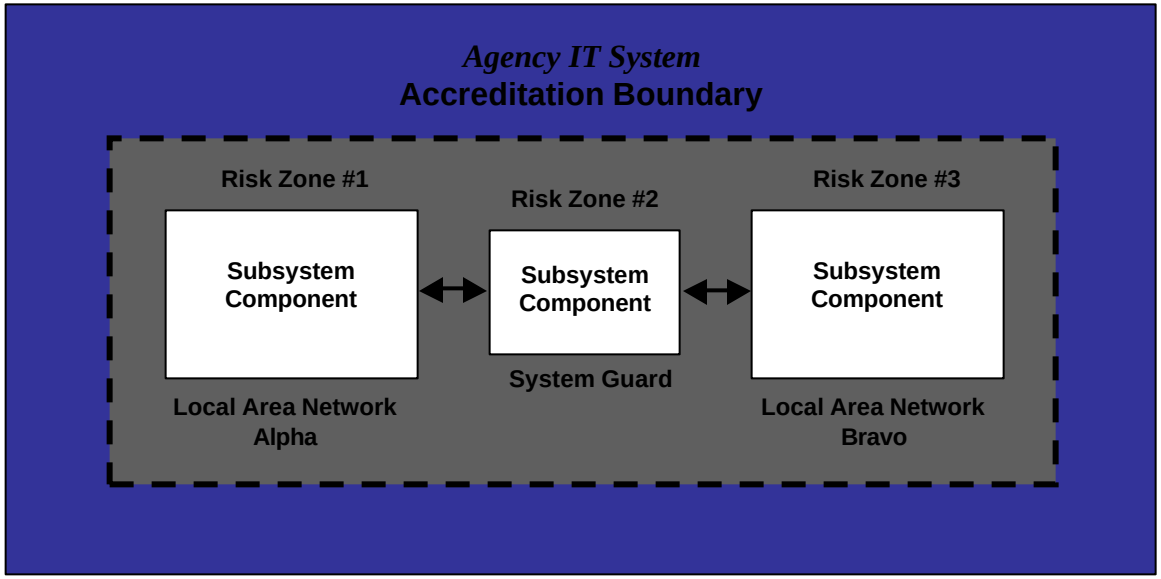
# Large and Complex Systems

- Establish the accreditation boundary for the IT system
- Define a set of system-level components, or subsystems, for both major applications and general support systems
- Subsystem decomposition facilitates the application of the C&A process in a more cost effective manner and supports the concepts of risk management and defense-in-depth
- Each subsystem component is fully characterized in the security plan and an appropriate set of security requirements and security controls identified for that component

# Large and Complex Systems

- Each subsystem component may be certified at a different certification level, depending on the levels of concern expressed by the agency
- The critical, high value subsystem components demand and receive more attention during the certification process than the less important, low-value subsystem components
- The final system accreditation may contain one or more subsystem components certified to the appropriate level based on the documented levels of concern and associated security controls

# Large and Complex Systems




- Security plan reflects the decomposition of the IT system into subsystems
- Each subsystem component is certified at the appropriate certification level
- Risk assessment applied to entire system; sum of subsystem component risks

# Certification Package

Key Documents---

- Security Plan
- Security Test & Evaluation Reports
- Final Risk Assessment Report
- Certifier’s Statement

# Security Plan

- Provides an overview of the security requirements for the IT system
- Describes the existing or planned security controls (management, operational, and technical) for meeting those requirements
- Delineates responsibilities and expected behavior of individuals who access the system

- The security plan is a living document that is updated throughout the system development life cycle as new information becomes available.
- Reference NIST Special Publication 800-18, *Guide for Developing Security Plans for Information Technology Systems*, December 1998.

# ST&E Report

- Documents the results of the ST&E activities (verification techniques and verification procedures used to demonstrate the security controls identified in the security plan are correctly implemented and effective)
- Developmental ST&E Report:
  - Applicable to new systems or systems undergoing major upgrades
  - Documents ST&E activities during the development and acquisition phase of the system development life cycle
- Operational ST&E Report:
  - Applicable to new, upgraded, or legacy systems
  - Documents ST&E activities during the implementation or operation/maintenance phases of the system development life cycle

# Final Risk Assessment Report

- Documents the results of the risk assessment activities and includes:
  - Threats to and vulnerabilities in the IT system
  - Proposals for and evaluations of the effectiveness of various security controls
  - Trade-offs associated with the security controls (e.g., performance impact and cost)
  - Residual risk associated with a candidate set of security controls

# Certifier’s Statement

- Provides an overview of the security status of the system and brings together, all of the information necessary for the DAA to make an informed, risk-based decision
- Documents that the security controls are correctly implemented and effective in their application
- Documents the security controls not fully implemented or implemented incorrectly and provides corrective actions

# Accreditation Decisions

- Full Accreditation
- Interim Accreditation
- Accreditation Disapproval

# Accreditation Package

- Conveys DAA's final accreditation decision
- Constructed from information provided in the certification package
- Normally consists of:
  - Accreditation letter
  - Security plan
  - Report documenting the basis for the accreditation decision

➢ Certain information from the security plan, ST&E reports, and risk assessment report may, at the discretion of the DAA, be withheld in the final accreditation package due to its sensitive nature.

Part III

# Security Certification Levels and Security Controls

# Key Security Factors

- Confidentiality
  - ✓ Assurance that information in an IT system is not disclosed to unauthorized persons, processes or devices
- Integrity
  - ✓ Assurance that information in an IT system is protected from unauthorized, unanticipated, or unintentional modification or destruction
  - ✓ Assurance that the quality of an IT system reflects the logical correctness and reliability of the operating system; the logical completeness of the hardware and software implementing the protection mechanisms; and the consistency of the data structures and occurrence of the stored data
- Availability
  - ✓ Assurance that information, services, and IT system resources are accessible to authorized users and/or system-related processes on a timely and reliable basis and are protected from denial of service

# Characterizing an IT System

- Examine the *criticality/sensitivity* of the system and the information the system processes, stores, and transmits
- Assess the *exposure* of the system and its information to both internal and external threats
- Assign appropriate *levels of concern* for both system criticality/sensitivity and exposure

# System Critical/Sensitivity

- The importance and nature of the information processed, stored, and transmitted by the IT system to the organization’s mission and day-to-day operations
- Measured by analyzing the system requirements for confidentiality, integrity, and availability

# System Exposure

A measure of the potential risk to an IT system from both external and internal threats:

- *External system exposure factors:*
  - ✓ Method by which users access the system, (e.g., dedicated connection, intranet connection, Internet connection, wireless network, PTS connection)
  - ✓ Existence of backend connections to the system and to what the backend systems are connected
  - ✓ Number of users that access the system
- *Internal system exposure factors:*
  - ✓ Security background assurances and/or clearance levels, access approvals, and need-to-know for individuals using the system

# Levels of Concern

**(Low, Moderate, High)**

- Level of concern for *confidentiality*
  - Based on the tolerance for unauthorized disclosure or compromise of information on the system
- Level of concern for *integrity*
  - Based on the tolerance for unauthorized modification or destruction of information on the system
- Level of concern for *availability*
  - Based on the tolerance for delay in the processing, transmission, or storage of information on the system or the tolerance for the disruption or denial of a service provided by the system

# Levels of Concern

**(Low, Moderate, High)**

- Level of concern for external exposure
  - Based on the definitions in SP 800-37 (user access method, backend connections, number of users)
- Level of concern for internal exposure
  - Based on the definitions in SP 800-37 (security background assurances/clearances, access approvals, need-to-know)
- Level of concern for total system exposure
  - Based on the values assigned to both external and internal exposure factors as defined SP 800-37 table

# System Characterization

Levels of concern for confidentiality, integrity, availability and system exposure determine:

- Security controls for the IT system
- Security certification level

# Security Controls

- Management Controls
  - Controls that address the security management aspects of the IT system and the management of risk for the system
- Operational Controls
  - Controls that address the security mechanisms primarily implemented and executed by people (as opposed to systems)
- Technical Controls
  - Controls that address security mechanisms contained in and executed by the computer system

# Management Controls

- Risk management
- System development/acquisition
- Configuration management
- System interconnection

# Operational Controls

- Personnel security
- Media protection
- Physical/environmental protection
- Contingency planning
- Incident response capability

# Operational Controls

- Hardware/system software maintenance
- System and data integrity
- Security awareness, training, and education
- Documentation

# Technical Controls

- Identification and authentication
- Logical access
- Audit
- Communications

# Security Control Selection

- Step 1: Characterize the IT system (based on system criticality/sensitivity and system exposure)
- Step 2: Select the appropriate minimum security controls for the system
- Step 3: Adjust the security controls (add or eliminate controls) based on system exposure and risk decisions

# Security Control Selection

- Select minimum security controls from the standard package of basic controls (mandatory for all systems) [NIST Special Publication 800-53]
- Select additional minimum security controls (moderate/high levels), if appropriate, to create a supplemental package of controls based on increased levels of concern for confidentiality, integrity, and/or availability [NIST Special Publication 800-53]
- Create agency-specific or technology-driven security controls [if needed security controls are not available in NIST Special Publication 800-53]

# Security Control Adjustment

- Adjust the selected controls based on internal and external system exposure and risk based decisions
- Document allowable security control substitutions and waivers in the security plan.

# System Security Controls


- Baseline of security controls for all IT systems from standard package
- Additional security controls in supplemental package based on increased levels of concern for confidentiality, integrity, and/or availability

# Certification Levels

- Security Certification Level 1
  - ✓ Entry-level security certification
- Security Certification Level 2
  - ✓ Mid-level security certification
- Security Certification Level 3
  - ✓ High-level security certification

# Security Certification Level 1

- Independent assessment of an IT system
- Appropriate for systems engendering:
  - Low levels of concern for confidentiality, integrity, and availability, or
  - Moderate to high levels of concern for confidentiality, integrity, and/or availability *and* systems operating in low to moderate risk environments
- Demonstrates at relatively low levels of assurance that the security controls for an IT system are correctly implemented and are effective in their application
- Employs simple verification techniques such as personnel interviews, documentation reviews, and observations
- Requires minimal resources

# Security Certification Level 2

- Independent assessment of an IT system
- Appropriate for systems engendering:
  - Moderate levels of concern for confidentiality, integrity, and/or availability, or
  - High levels of concern for confidentiality, integrity, and/or availability *and* systems operating in low to moderate risk environments
- Demonstrates at moderate levels of assurance that the security controls for an IT system are correctly implemented and are effective in their application
- Employs standard, commercially available, assessment tools and verification techniques
- Requires limited to moderate resources

# Security Certification Level 3

- Independent assessment of an IT system
- Appropriate for systems engendering high levels of concern for confidentiality, integrity, and availability
- Demonstrates at high levels of assurance, that the security controls for IT systems are correctly implemented and are effective in their application
- Employs the most advanced assessment tools and verification techniques available
- Requires substantial resources

# Certification Level Selection

- Step 1: Characterize the IT system (based on system criticality/sensitivity and system exposure)
- Step 2: Select the appropriate initial security certification level for the system
- Step 3: Adjust the security certification level based on system exposure and risk decisions

Part IV

# Verification of Security Controls

# Verification Techniques

**SCL-1 Certifications**

- Low intensity, checklist-based, independent security review
- Interview of personnel
- Review of system-related security policies, procedures, and documents
- Observation of system operations and security controls

# Verification Techniques

**SCL-2 Certifications**

- Moderate intensity, demonstration-based, independent assessment
- Functional testing
- Regression analysis and regression testing
- Penetration testing (optional)
- Demonstrations to verify security control correctness and effectiveness
- SCL-1 verification techniques (if appropriate)

# Verification Techniques

**SCL-3 Certifications**

- High intensity, exercised-based, independent assessment
- System design analysis
- Functional testing with coverage analysis
- Regression analysis and regression testing
- Penetration testing (Red Team optional)
- Demonstrations and exercises to verify security control correctness and effectiveness
- SCL-1 and SCL-2 verification techniques (if appropriate)

# Verification Procedures

- Describes the specific assessment activities carried out by the certifier and the certification team to demonstrate the correct and effective implementation of security controls
- Uses suggested verification procedures from NIST Special Publication 800-53A (projected for Spring 2003) as the starting point for developing more platform-specific ST&E procedures
- Additional specificity in ST&E procedures provides greater consistency and repeatability of testing from certifier to certifier

Part V

# The Security Certification and Accreditation Process

# Phases of the C&A Process

- Pre-certification Phase
- Certification Phase
- Accreditation Phase
- Post-accreditation Phase

# Pre-certification Phase

- System Identification
- Initiation and Scope Determination
- Security Plan Validation
- Initial Risk Assessment Validation
- Security Control Validation / Identification
- Negotiation

# Certification Phase

- Verification Procedure Refinement
- Security Test and Evaluation (ST&E)

# Accreditation Phase

- Final Risk Assessment
- Security Plan Update
- Certification Findings
- Accreditation Decision

# Post-accreditation Phase

- Risk Assessment Update
- System and Environment Update
- Reaccreditation
- System Disposal

Part VI

# Future Activities and Events

# Key Milestones

- NIST Special Publication 800-37 (draft) released for public review

  **28 October 2002**

- Public Comment Period

  **28 October 2002 through 31 January 2003**

- Comments to NIST Computer Security Division

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➢ Note: NIST Special Publications 800-53 and 800-53A projected for completion and public review in Spring 2003

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